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Zheng Yang adopts casting simulation to speed up complex die design

正揚製模廠
ZHENG YANG MOULD MANUFACTORY

THE CHALLENGE

When new products become more complex by the day, past experience isn't enough to come up with good die designs, to optimize them through limited trials, to deliver quality dies to the end customer, and at the same time maintain a good profit margin. For Zheng Yang, simulation is the answer to this challenge.

Experienced die designers, with no significant experience in Computer Aided Engineering (CAE) software, were able to successfully adopt simulation within the traditional die design cycle and thereby save on development costs and time.

THE BENEFITS

- Reduce development time and cost, by cutting needless trials to optimize the die design and process parameters.
- Enhance competitiveness in the market.
- Develop greater experience and hence higher internal expertise.

"If time and cost weren't constraints, we could solve many issues without simulation. Thanks to ESI's QuikCAST casting simulation software, we can test and improve our designs, while building our internal expertise relative to various scenarios unseen before."

Tu, Chin-Huang,
General Manager,
Zheng Yang Mould Manufactory, Taiwan

Zheng Yang Mould Manufactory is a tool and die-maker developing dies for aluminium and magnesium alloys produced by High Pressure Die Casting. Traditionally, they developed these dies using a trial and error approach.

New orders arriving at Zheng Yang, involved increasingly complex product shapes and higher quality. Experience from previous designs wasn't always sufficient to assure an initial design that was a good starting point for trails. Consequently multiple trials and redesign was required, resulting in increased development costs for Zheng Yang, lower margins, and delays in die delivery and their customers' end production.

Applying simulation to the early stages of die design

Zheng Yang looked to CAE as a path to minimizing risk and reduce delays. They selected QuikCAST, ESI's fast and efficient simulation solution for casting process evaluation, to perform virtual trials on preliminary die designs. Zheng Yang started collaborating with ESI's official agent, Elite Crown, located in Taiwan.

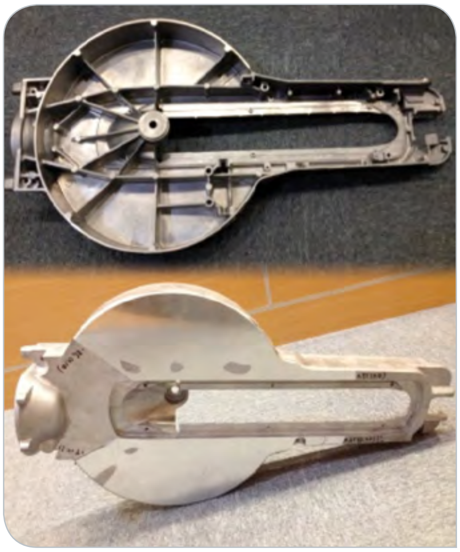
Successful implementation

With no significant previous knowledge in CAE, it was important for Zheng Yang Mould Manufactory to choose a partner who could help them to successfully implement casting simulation, learning not only correct usage of the software tool, but more importantly the right methodology. Elite Crown brought this support to Zheng Yang and enabled them to deploy QuikCAST successfully in their die design cycle.

Most of the simulations they performed aimed at correcting filling and solidification defects, especially those linked to air entrapment, surface defects and shrinkage porosity. Elite Crown focused on filling simulation (coupled with thermal effects to consider the evolution of die temperatures changing the viscosity of the molten metal), to tackle these defects. Based on these simulations, Zheng Yang was able to introduce process modifications and design modifications for the filling system. Design of the filling system included runner profile and positioning, gate balancing, and placement of overflows.

A sample engineering study

One of the recent challenges for Zheng Yang designers was to develop the right die design for an aluminum pad casting of a circular saw machine and achieve high integrity surface quality.



Preliminary designs

With no past experience in designing such parts, Zheng Yang designers came up with two different filling approaches (Fig 1). Design 1 had a vertical orientation, while Design 2 had a horizontal orientation. In such situations, simulation software offers the possibility to test both designs virtually, with no fear of having to cut the dies.

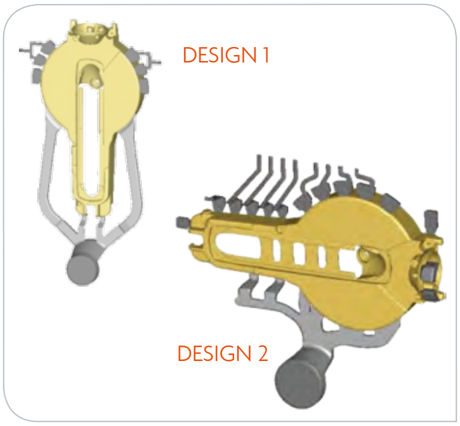


Fig 1: Design options

DESIGN **1** ANALYSIS: The team was inclined towards Design 1, as it required less material in the feeding system, but recognized there was an uncertainty on the filling behavior, due to the possible long flow lengths.

Simulation revealed that the central runners were small, and the metal did not feed the long bars of the pad as intended. The side runners, bigger in size, had quicker flow, reaching the circular section of the pad. As the major part of the circular section of the cavity was getting filled, back feeding to the long bars occurred (Fig 2 left). This back filling was a bad sign, as the long bars were filling last, with consequent longer exposure, lower temperatures and higher volume of oxides occurring inside the cavity, leading to air entrapments (Fig2 right).

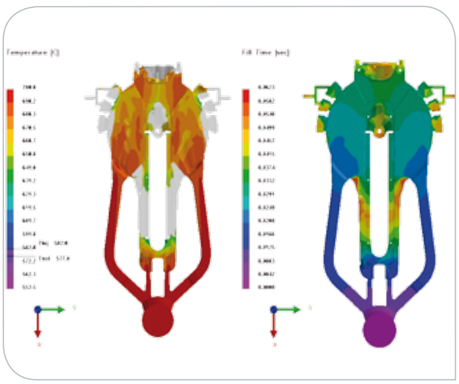


Fig 2: Design 1 simulation. On left are the filling temperatures and on right is the fill time plot.

DESIGN **2** ANALYSIS: Though requiring more metal in the feeding system, Design 2 seemed a safer bet, as the length of travel of molten metal in the cavity was on average half when compared to Design 1, leading to lower exposures of the molten metal to the air inside the cavity. The filling (Fig 3) in the circular cavity was quite uniform. At half distance on the top half of the circular section, more metal arrived from the 2nd internal gate (from right) located between the 2 long bars and caused a non-uniform profile. The overflows seemed to be mostly positioned at the right locations. Filling analysis on the long bars revealed that the flow fronts joined on the upper long bar, instead of the overflows. This led to consider adding or modifying the internal gates to enable the metal to flow into the region earlier on.

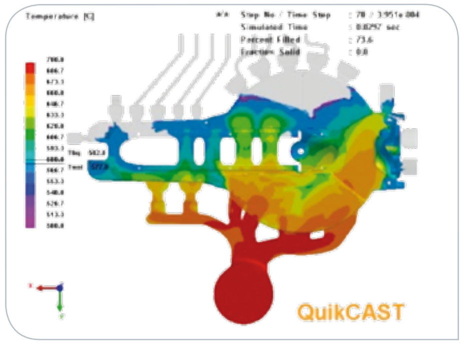


Fig 3: Design 2 simulation

Final design

Zheng Yang based their final design on Design 2, with minor modifications to the gating profile. These modifications were mainly in the internal gates between the 2 long bars of the pad to achieve a better flow balance (Fig 4).

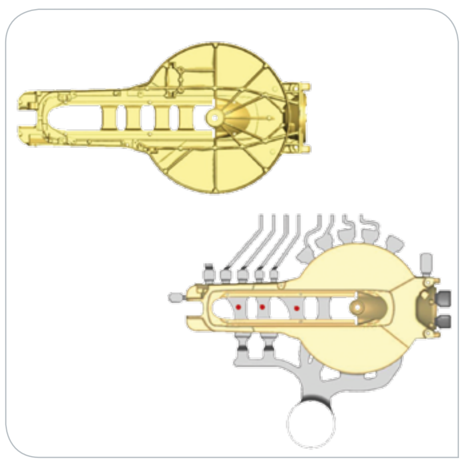


Fig 4: Final Design in comparison with Design 2 (on top).

The 2nd internal gate (from right) in Design 2 was redesigned and repositioned to divert the flow slightly towards the long bars, so as to achieve more uniform flow on the circular section while reaching the top overflows. The 2nd internal gate (from left) was converted as an overflow and repositioned, allowing metal flow only from the top long bar, with no metal flow across the bars. The left most ingate was redesigned and repositioned to make the flow happen from the bottom bar to the upper bar through this gate, and end up in the overflows on top of the bar.

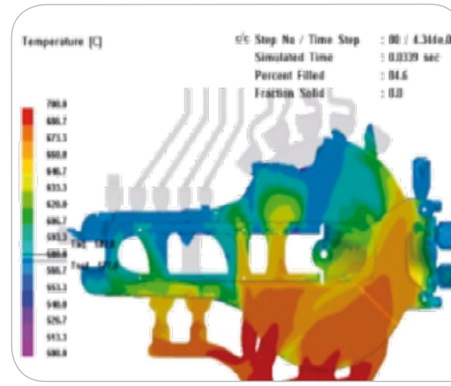


Fig 5: Final Design Simulation

Simulation on the final design (Fig 5) reveals improved flow characteristics, with better placed internal gates, helping to obtain a high surface quality.

Zheng Yang also performed solidification analysis simultaneously in each design trial, and made corresponding modifications in the die and process to eliminate unwanted porosity. The team made a trial run on this final design, before dispatching the die to their end customer.

Better and faster method with QuikCAST

In-house implementation of QuikCAST enables Zheng Yang to reduce the development time and cost, thereby enhancing their competitiveness. Multiple simulations provide greater insight into the happenings inside the die cavity; a much less expensive alternative to real trials. Simulation allows detailed and sequential analysis of each design / process scenario, and provides the flexibility to try out different designs, thereby also helping develop in-house experience and expertise. Ultimately, ESI's casting simulation software empowers Zheng Yang Mould Manufactory to meet their customers' needs for faster and better quality dies.

ABOUT ZHENG YANG MOULD MANUFACTORY

Zheng Yang Mould Manufactory was established in 1993 and it's located in the Taichung City of Taiwan. The company is a tool & die-maker producing dies for the High Pressure Die Castings of Aluminium & Magnesium alloys supplying to the automotive, machinery & electronic industry. Their main parts include 3C product cases, lampshades, crankcases, cylinder head, gearbox, housings and bi-cycle forks.

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ABOUT ESI GROUP

ESI is a pioneer and world-leading provider in Virtual Prototyping that takes into account the physics of materials. ESI boasts a unique know-how in Virtual Product Engineering, based on an integrated suite of coherent, industry-oriented applications. Addressing manufacturing industries, Virtual Product Engineering aims to replace physical prototypes by realistically simulating a product's behavior during testing, to fine-tune fabrication and assembly processes in accordance with desired product performance, and to evaluate the impact on product use under normal or accidental conditions. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping. These solutions are delivered using the latest technologies, including immersive Virtual Reality, to bring products to life in 3D; helping customers make the right decisions throughout product development. The company employs about 1000 high-level specialists worldwide covering more than 40 countries. ESI Group is a French company listed in compartment C of NYSE Euronext Paris.

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